



Maximum Likelihood Approach for Reliability Estimation of the Confidence Interval in 2022 NECO BECE Social Studies Multiple Choice Test Item in Benin Metropolis of Edo State

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Abstract

The study examined the reliability index in 2022 Basic Education Certificate Examination (BECE) Social Studies multiple choice test items conducted by National Examination Council (NECO) using Maximum Likelihood Estimate (MLE). Specifically, the study also examined the reliability index with respect to school location, sex of students and school ownership. To guide the study, four research question were raised and three hypotheses were formulated. Survey Research design was adopted in carrying out this research. The population comprised all 164,466 Junior Secondary School three (JSS 3) Social Studies students from 247 public and private schools in Benin Metropolis, Edo State. The sample for the study was 320 students drawn from 16 junior secondary school students in public and private schools. The proportionate stratified and the simple random sampling techniques were used to select the schools and the students from each of the three Local government areas of Benin Metropolis. The instrument for data collection was the 2022 BECE Social Studies multiple choice item examination by NECO. The instrument is a standardized test that has been content validated by the examination body (NECO). The reliability of the items was re-established using Kuder-Richardson 20 to obtain a reliability coefficient of 0.71, indicating a high reliability estimate of the instrument. Data collected for the study were analysed using Maximum Likelihood of the confidence interval with Statistical Package for Social Science (SPSS). The findings of the study revealed that the 2022 Social Studies multiple choice test items of Basic Education Certificate Examination (BECE) by National Examination Council (NECO) is reliable. The study also revealed no significant difference by school location, sex of students and school ownership in the reliability index of the test items using the Maximum Likelihood Estimation Method of the confidence interval. Based on the findings, it was recommended, that examination bodies involved in BECE can use either of school location, sex of students, school ownership within the geographical population of the examination to determine the reliability index of their test items.

Keywords: Maximum Likelihood; Reliability; Confidence Interval; Social Studies; Multiple Choice Items



Introduction

In the school system round the world, decisions about students' progress are based on data collected via assessment which comes from either classroom or standardized tests. At the end of the Junior Secondary School (JSS) stage which is upper basic education, students are expected to write the Basic Education Certificate Examination (BECE) administered by National Examination Council (NECO) and State Ministry of Education (SMOE). The core subjects in this examination are English language, Mathematics, Science, Technology, Native (Edo) Language and Social Studies. These subjects are in addition to the number of elective subjects that the students are tested in the examination. This examination is important as it is both for certification and selection to senior secondary schools and technical colleges.

Social studies is studied by students not only because of its importance but also because of the naturally existing or perceived relation between Social studies and other subjects. Social studies is a fundamental school subject which serve as a basic index for understanding social science- related subjects as well as key role in shaping how individuals deal with various spheres of private, social and civil life. It is a compulsory school subject in Nigeria educational system, especially at the primary and junior secondary school levels of education as stated in the National Policy of Education (FRN, 2018). The competencies gained in the study of social studies at the junior secondary school level of education in Nigeria are widely used in all spheres of human life.

Beyond having the opportunities to learn about the future roles in the society as students, it also enables the students to be fully abreast of the dos and don'ts in the society in performing their anticipated roles. In this way, it helps every individual to develop the right attitude in showing respect for the law of the land and maintaining a healthy relationship among different citizens in the society. Social studies programmes include experiences that promote the study of cultures and cultural diversity (National Curriculum Standard for Social Studies-NCSS, 2011). Any student who has been exposed to social studies teaching and learning experiences is expected to a competent citizen that is will be able to coordinate the affairs of the state. He or she duly carries out his or her assigned responsibilities as a citizen with little or no supervision and has the ability to relate and work with people from any different background be religious, political, cultural or economic. Social Studies builds sociable understanding, encourages civil efficiency, teaches critical thinking, breeds character and provide students with an understanding of their role as citizens in a democratic society (Daramola & Olanireti, 2019). In other words, the learning of social studies makes a citizen to fully comprehend the duties, responsibilities and obligations of a citizen to his or her fellow citizens and the state. This implies that, as a subject it creates in students the positive attitude towards taking active roles in their future endeavours and the future of their countries.

With the importance of social studies as a subject matter in education and for the positive advancement of the society, there is an increased desire for the effectiveness and improvement of teaching and learning of the subject in Nigeria Junior Secondary School levels of education. Despite this effort that has been put in place to improve upon the teaching and learning of the subject, the performance of students in the subject has been unsatisfactory. Report from 2022 Edo State Ministry of Basic and Senior Secondary Education Basic Education Certificate Examination pointed out unsatisfactory performance of students in social studies in Nigeria. The report highlighted the pass rate in social studies as 77.52% in 2020, 67.68% in 2021 and 63% in 2022. A lot of concerns have been expressed on the state of education in Nigeria, and in spite of the benefits of this subject, the performance of students in this subject tend to be unsatisfactory. Asim (2007); Enu & Okwilagwe, (2015) attributed these



concerns to poor testing items. Items of good quality is the first requisite of a test that is judged satisfactory and one of the criteria that ascertains the quality of a good test is reliability.

A test is reliable if it measures all what it is supposed to measure consistently under all conditions. Similarly, it is the extent to which repeated measure give consistent results for the individual examinees. An instrument is considered reliable if it is consistent in measuring similar construct over a period of time. Reliability is used to cover several aspects of consistency of scores. It indicates the extent to which individual differences in scores are attributable to true differences in the characteristics being measured as well as the extent to which they are attributable to chance errors. It therefore, means that, reliability is the dependability or trustworthiness of a test. Test reliability is how dependably or consistently a test measures a characteristic. The reliability of a test instrument is the test property that makes it possible for an instrument to yield similar scores for a person who repeats the test and when this happens it is believed that the instrument measures a characteristic reliably (Imasuen and Orheruata, 2022; Oribhabor & Osaze, 2016). When a test instrument is consistently yielding results that is not approximately the same on different administrations on the same students, such instrument is not trustworthy and dependable, and therefore not reliable.

There are situations where an instrument does not yield similar score over time. Any testing condition that is not uniform such as testing environment, instruction, time among others that is irrelevant to the purpose of the test tend to increase the error variance and making the scores less reliable. An instrument used in measurement process is necessary to be reliable but not a sufficient condition to measure what it is expected to measure. An individual's score on a test is expected to be his true ability on such test. Uwah et al. (2020) stated that errors could creep in during the course of the measurement process arising from preparation of the test (poor knowledge of the measurement procedure, subjective elements, examiners mannerism, cultural, tribal and religious biases), the length of the test (which could be too long or too short) which may not be well considered, or perhaps the testing environment (which may not be adequate enough), all these may affect the outcome of the result systematically and may be very difficult to locate and remove. Kline (2000) noted some of the reasons that could account for this as variation in conditions under which the test is administered, errors of sampling, item difficulty, range of the group, the ability level of students who took the test, length of the test, operations for estimating the reliability and faulty marking procedure among others.

Research has shown that, the reliability of any instrument is dependent on range of skills and ability of the group measured. If the group measured has a wide range of skill or abilities, then the reliability will be higher than if the group has a narrow range of skill or abilities, however the level of students' ability and skills have been found to be greatly influenced by the indispensable role of school location, sex of students and school ownership (Kline, 2000). It has been reported that school location, sex of students and school ownership are some of the factors that influence students' skills and ability or cause score inconsistency in mathematics in the educational system (Eromosele & Victory, 2024; Samuel & Yomi, 2024).

School location refers to the physical land area where a school is domicile and is classified as either urban or rural depending on whether facilities such as leisure and relation, accessible transportation, portable water, cultural heterogeneity and multi-ethnicity are available. The school location could be related to the differences in the quality of instruction and facilities. The quality of instruction and facilities from one school location to another can create difference in the level of knowledge and skills acquired by the students. The learning



facilities students are exposed to, social- economic effect and quality of instruction can affect their academic performance. The sex of students refers to the biological representation of an organism which relates to the organism as male or female. Within the classroom setting, the male and female students are taught together by same subject teachers under the same circumstances, regardless of their sex. In other words, personal features of students such as sex are not taken into account throughout teaching and learning once they are in the same class. However differential performance by sex appears to influence students' knowledge and skills gained in certain subject than the other and therefore making the instrument not being reliable by making a test instrument to yield inconsistent result upon different administration on the same or similar respondents. School ownership refers to the proprietorship of a school. The ownership of schools in Nigeria is divided into public ownership and private ownership. Most students who are in public schools are children from low income earners. It is high income earners children that can afford to go to private schools as better facilities are in private schools, which tend to give more advantage to children of high income earners that are there than in the public schools. Students' low level of skill and knowledge gained in a particular subject rest more on the public schools than in the private schools. Most of the students admitted into higher institutions came from private schools (Alimi, et al; 2012; Uline and Megan, 2008).

There are different methods of estimating reliability of test among which are test-retest method, alternate or equivalence method, split half method, Cronbach Alpha method, inter-rater method and Kuder- Richardson reliability method. Test-Retest reliability measures how two results agree with each other, when the test is administered repeatedly to the same sample at different point in time. Alternate or equivalent method involves administration of an Equivalent or parallel form of test to the same group of examinees in succession and the scores obtained are correlated. Split-half method requires an examiner to administer the test once and is then subdivided into two halves for scoring. Cronbach Alpha provides estimate for test which items are scored dichotomously and essay test having items of varying point values or rating scales. Inter-rater reliability (also called inter observer reliability) is used to determine the degree of uniformity between different people who observe or assess similar event (Agi, 2021; Omorogiuwa, 2019). The Kuder-Richardson method involves administering the test once and it assesses the inter- item consistency or homogeneity of the items making up a test. It is often used when items in the test are scored dichotomously (right or wrong). Kuder-Richardson formulas 20 and 21 (also known as K-R20 and K-R21, are the most frequently reported internal consistency estimates of the K-R20. However, the difference between the K-R20 and K-R21 lies in their assumptions about the difficulty of the test items. While K-R21 assumes that all the item in a test are of equal difficulty, K-R20 has no such assumption. This claim is supported by Eyong (2021) who stated that they provide a sound and well-meaningful estimate, that is a conservative or safe estimate of the reliability of a set of test results. The problems of measurement error that continue to surface in point estimation of reporting reliability paves way for interval estimate. An interval estimate of a parameter is an interval or a range of values used to estimate the parameter and it is a specific interval estimate of a parameter determined by using data obtained from a sample and by using the specific confidence level estimate (Imasuen and Orheruata, 2022). Confidence interval estimation is regarded as a preferable way of presenting study results because it encompasses hypothesis testing (Altman, 2005). One of the methods for constructing confidence intervals in a study with variable class sizes or class width is the Maximum likelihood estimator.

Maximum likelihood estimator (MLE) is a statistical method used to estimate parameters by maximizing the likelihood function of a given observed data. MLE is one of the effective tools of obtaining reliability estimates. For reliability estimation, the MLE approach

assumes a known probability distribution, commonly a normal or logistic distribution and it helps to determine the parameters that are most likely to produce the observed data by maximising the likelihood function. According to Yekti, et.al; (2024), the maximum likelihood method is a method used in estimating the parameters of an assumed probability distribution, given some observed data by searching for the maximum value of the likelihood function. It is often used when the distribution parameter estimates are more precise; the estimated variance is smaller; confidence intervals and tests for model parameters can be reliably calculated; the calculations use more of the information in the data and when there are only a few failures because the data are heavily censored. Xianghong (2016) observed that the accuracy of MLE is not affected by varying sample size. This implies that maximum likelihood estimation is as effective with small size sample as it is in a large sample size. He added that maximum likelihood estimation method is a traditional means through which one can estimate the behaviour and properties of the population without the necessity of obtaining the data with size of or near the whole population.

Maximum Likelihood Estimation (MLE) treats parameters as fixed but unknown quantities Diogo (2024). Hence, it holds that the true value of an estimation is fixed and can only be known through its estimation process. The method finds the value of an estimate that makes the estimated or observed value most likely outcome or expected value from the data being observed. That is, it gives an estimated value, of an observed data that is most likely and exactly with the unknown or expected and fixed value that happens to be the true parameter of the population. For instance, if the researcher is to determine the true population of getting heads from a coin tossed 100 times and observe 60 heads and 40 tails. The MLE can be applied to estimate the true probability of getting heads. In this case, MLE would find the value of the probability (parameter) that makes the observed data (60 heads, 40 tails) the most likely outcome. This is achieved by maximizing a likelihood function so that, under the assumed statistical model, the observed data is most probable. The point in the parameter space that maximizes the likelihood function is called the maximum likelihood estimate (Rossi & Richard, 2018). In the same vein, a test item can have the chances or probability of being reliable or being not reliable with its true parameter fixed and yet unknown until after it has been estimated. The MLE enables the user to get the value that is most likely and exactly the same with the true reliability index of a test item when applied to estimate a set of an observed data thereby making the estimated outcome the same as the expected outcome or unknown reliability index. In other word it maximises the likelihood of having an observed scores closest to or the same as the true population parameter. In this way, it minimises the chances of obtaining the estimate value that is at variance from the true population parameter. With the application of maximum likelihood to estimating the population parameter, it gives an estimated or an observed value that converges into the true or expected population parameter.

Given the significance of social studies in a nation building as it helps to make valid decisions based on the test score, it becomes pertinent to ensure its quality as such data generate confidence in what will be obtained as score in test are influenced by errors. An obtained score can either be over estimation or an underestimation of an examinees true score. It is therefore, important to determine the extent to which a test score is free from error. Hence, if a measuring instrument is yielding inconsistent result upon different administration on the same or similar respondents, such instrument is not reliable and scores obtained from such will provide misleading interpretation. Empirical documentation on estimation of the reliability index using confidence interval in Benin metropolis compared different confidence interval methods in order to establish the best methods with paucity of information on the consideration of the influence of sub group population such as school location, sex of students and school ownership

on estimating reliability using maximum likelihood method. Hence this study, to investigate the reliability index of Basic Education Certificate Examination (BECE) by National Examination Council (NECO) 2022 Social Studies Multiple Test Items in Benin Metropolis using Maximum Likelihood Estimation Method of the Confidence Interval based on School Location, Sex of students and School Ownership.

Research Questions

1. What is the reliability index of the 2022 BECE Social Studies multiple choice test items conducted by National Examination Council (NECO) using the Maximum Likelihood Estimation method?

Hypotheses

1. There is no significant difference in the reliability index of the 2022 Basic Education Certificate Examination (BECE) Social Studies multiple choice test items conducted by National Examination Council (NECO) using the Maximum Likelihood Estimation method based on school location.
2. There is no significant difference in the reliability index of the 2022 Basic Education Certificate Examination (BECE) Social Studies multiple choice test items conducted by National Examination Council (NECO) using the Maximum Likelihood Estimation method based on sex of students.
3. There is no significant difference in the reliability index of the 2022 Basic Education Certificate Examination (BECE) Social Studies multiple choice test items conducted by National Examination Council (NECO) using the Maximum Likelihood Estimation method based on school ownership.

Methods

The descriptive survey research design was employed. This research design was considered appropriate as it aimed at gathering data from a sample to generalize the population. The population for the study comprised all 164,466 Junior Secondary School three (JSS3) Social studies students from the 247 public and private schools in Benin Metropolis, Edo State. There are three Local Government Areas (LGAs) in Benin Metropolis, namely: Egor, Ikpoba Okha and Oredo. The population of the public junior secondary schools in these LGAs are 12, 21 and 12 schools respectively while the population for registered private junior secondary schools in these LGAs are 75, 80 and 45 respectively making a total of 247 junior secondary schools in Benin Metropolis as obtained in Edo State Ministry of Education (2022). The sample for the study was 320 students drawn from 16 junior secondary school three students in public and private schools in Benin Metropolis. The Proportionate stratified and simple random sampling techniques were adopted in selection of the sample. Firstly, the proportionate stratified sampling technique was used to select 2 public and 3 private schools from Egor LGA, 3 public and 3 private schools from Ikpoba Okha LGA while, 3 public and 2 private schools from Oredo LGA making a total of 8 public and 8 private schools. This selection represented 20% for public schools and 4% for private schools in each of the LGAs. Secondly, the simple random sampling technique was used to select 20 students for each of the schools sampled which gave a total of 320 students. The Basic Education Certificate Examination (BECE) 2022 Social studies multiple choice items conducted by the National Examination Council (NECO) was used for data collection. The instrument contains 30 items that was developed by National Examination Council (NECO) while the researcher added the demographic variables under study. The instrument used for the study is standardized one administered by National

Examination Council (NECO) which is assumed to have undergone the process of content validity and as such process of validity was skipped. The reliability of the instrument was re-established using Kuder-Richardson 20 method which gave the reliability coefficient of 0.71 indicating that the instrument was reliable. Data collected for the study were first standardize using Z and T- score for uniformity before employing the maximum likelihood approach. Thereafter, the Maximum Likelihood Estimation Method using confidence interval was used to answer the research questions and test for the hypotheses.

Results

Research Question One: What is the reliability index of the 2022 BECE Social Studies multiple choice test items conducted by National Examination Council (NECO) using the Maximum Likelihood Estimate?

Table 1: Reliability Index of the Basic Education Certificate Examination (BECE) by National Examination Council (NECO) 2022 Social Studies Multiple Choice Test Items Using Maximum Likelihood Estimate (MLE)

Number of Items	30
Number of Students	320
Kuder-Richardson 20	0.71
Standard Error (MLE)	0.03997
$Z_{\frac{\alpha}{2}}$	1.96
Confidence Interval	0.71 ± 0.078
MLE	(0.63, 0.79)

Table 1 displays a Kuder-Richardson reliability index of 0.71 and the standard error estimate for the Maximum Likelihood Estimate (MLE) of the Basic Education Certificate Examination (BECE) by National Examination Council (NECO) 2022 Social Studies multiple-choice test items. Additionally, it indicates that the MLE of the reliability falls within the range of 0.63 to 0.79.

Hypothesis One: There is no significant difference in the reliability index of the 2022 BECE Social Studies multiple choice test items conducted by National Examination Council (NECO) using the Maximum likelihood Estimate based on school location.

Table 2: Reliability Index of the Basic Education Certificate Examination (BECE) by National Examination Council (NECO) 2022 Social Studies Multiple Choice Test Items Using Maximum Likelihood Estimate (MLE) Based on Location

	Rural Schools	Urban schools
Number of Items	30	30
Number of Students	160	160
Kuder-Richardson 20	0.74	0.67
Standard Error (MLE)	0.0382	0.042
$Z_{\frac{\alpha}{2}}$ Confidence	1.96	1.96
Interval Width	0.74 ± 0.075	0.67 ± 0.083
MLE	(0.67, 0.81)	(0.59, 0.75)
Interval	0.14	0.16

Table 2 presents the maximum likelihood estimation (MLE) reliability ranges for rural and urban schools, which are between 0.67 and 0.81, and 0.59 and 0.75, respectively. The

interval widths of 0.14 and 0.16 indicates no significant difference. Consequently, the null hypothesis, which posits that there is no significant difference in the reliability index of the Basic Education Certificate Examination (BECE) by National Examination Council (NECO) 2022 Social Studies multiple-choice test items based on location, is retained.

Hypothesis Two: There is no significant difference in the reliability index of the 2022 BECE Social Studies multiple choice test items conducted by National Examination Council (NECO) using the Maximum Likelihood Estimate based on sex of students.

Table 3: Reliability Index of the Basic Education Certificate Examination (BECE) by National Examination Council (NECO) 2022 Social Studies Multiple Choice Test Items Using Maximum Likelihood Estimate (MLE) Based on Sex

	Male Students	Female Students
Number of Items	30	30
Number of Students	160	160
Kuder-Richardson 20	0.77	0.62
Standard Error (MLE)	0.0362	0.0445
$Z_{\frac{\alpha}{2}}$	1.96	1.96
Confidence Interval	0.77 ± 0.071	0.62 ± 0.087
MLE	(0.70, 0.84)	(0.53, 0.71)
Interval width	0.14	0.18

Table 3 presents the Maximum Likelihood Estimate (MLE) reliability ranges for male and female students, which are between 0.70 and 0.84, and 0.53 and 0.71, respectively. The interval widths of 0.14 and 0.18 indicates no significant difference. Consequently, the null hypothesis, which posits that there is no significant difference in the reliability index of the Basic Education Certificate Examination (BECE) by National Examination Council (NECO) 2022 Social Studies multiple-choice test items based on sex, is retained.

Hypothesis Three: There is no significant difference in the reliability index of the 2022 BECE Social Studies multiple choice test items conducted by National Examination Council (NECO) using the Maximum Likelihood Estimate based on school ownership.

Table 4: Reliability Index of the Basic Education Certificate Examination (BECE) by National Examination Council (NECO) 2022 Social Studies Multiple Choice Test Items Using Maximum Likelihood Estimate (MLE) Based on School Ownership

	Public Schools	Private Schools
Number of Items	30	30
Number of Students	160	160
Kuder-Richardson 20	0.65	0.74
Standard Error (MLE)	0.0431	0.0382
$Z_{\frac{\alpha}{2}}$	1.96	1.96
Interval	0.65 ± 0.084	0.62 ± 0.075
MLE Confidence	(0.57, 0.73)	(0.67, 0.81)
Interval width	0.16	0.14

Table 4 presents the Maximum Likelihood Estimate (MLE) reliability ranges for public and private schools, which are between 0.57 and 0.73, and 0.67 and 0.81, respectively. The interval widths of 0.16 and 0.14 indicates no significant difference. Consequently, the null hypothesis, which posits that there is no significant difference in the reliability index of the



Basic Education Certificate Examination (BECE) by National Examination Council (NECO) 2022 Social Studies multiple-choice test items based on school ownership, is retained.

Discussions

The findings from research question one reveals the standard error estimate for the Maximum Likelihood Estimate (MLE) of Confidence Interval for the Basic Education Certificate Examination (BECE) by National Examination Council (NECO 2022 Social Studies multiple-choice test items. Additionally, it indicates that the items are reliable as it lie between the lower and upper width. The findings from the studies establishes the findings of Imasuen and Orheruata (2022), who reported that, when the amount of error is low, the reliability of the measurement is high. According to them, it is the amount of error that indicates how reliable a measurement is. This is in agreement with Erfold (2013) and Meyer (2010) that when the amount of error is large, the reliability of the measurement is low. The result from hypothesis one reveals that, there is no significant difference in the reliability indexes of the Basic Education Certificate Examination (BECE) by National Examination Council (NECO) 2022 Social Studies multiple choice test items using the Maximum Likelihood Estimate of the Confidence Interval between Urban and Rural schools. From the result, it implies that both urban and rural schools are intellectually inclined in the subject they were being examined on. This finding agrees with the findings from Kline (2000) who noted that one of the factors that can influence reliability estimation is the ability level of students who took the test. Accordingly, for the difference in reliability between Urban and Rural school to be insignificant, it implies that the ability level or skills of both Urban and Rural students used for the study in the subject are high, in the same vein, it further suggests that, both Urban and Rural schools have access to qualified human and non-material resources that enhance effective teaching and learning that leads to increased ability level and reduces the chances of guessing during examination as noted in the findings of (Essien, 2019). Again, having a reliability index between Urban and Rural schools that are not significant could mean both urban and rural students have access to good teaching and learning resources that lead to increase in their skills and ability level of the students in the subject thereby leading to increase in both reliability indexes such that their differences in reliability was not significant. The findings disagree with Flower and Helbery (2009) who found out that school location in most secondary schools which is characterized with rural schools where poor and learning environment is not encouraging, can ultimately result in poor reliability estimate as a result of poor ability level of students that are occasioned by poor learning facilities in rural areas.

The result from hypothesis two reveals that, there is no significant difference in the reliability index of the Basic Education Certificate Examination (BECE) by National Examination Council (NECO) 2022 Social Studies multiple choice test items using the Maximum Likelihood Estimate of the confidence Interval based on sex. From the result, it implies that both male and female students are intellectually inclined in the subject they were being examined. This agrees with the findings of Livingstone (2018) who observed that the most important factors (and usually the one with the greatest influence) is the extent to which the test taker has knowledge and skill that the test is supposed to measure; stating that if the group has a wide range of skill or abilities, then the reliability will be higher than if the group has a narrow range of skill or abilities. This implies that both the male and female used for the study were taught by qualified teachers that made both of them to be intellectually include thereby making one group not to be more or less intellectually include than the other in terms of male and female used for the study hence leading to insignificance difference between the reliability index of male and female students. This disagrees with the view of Rindskopf (2021)

who observed that reliability is dependent on the variation in the group used to develop the test. This suggests that if the group of students say male used are more intellectually inclined, than another group of students say female used for the test; the reliability estimate of male who are more intellectually inclined will be higher than the other group, female group of students who are less intellectually inclined.

The result from hypothesis three reveals that, there is no significant difference in the reliability index of the Basic Education Certificate Examination (BECE) by National Examination Council (NECO) 2022 Social Studies multiple choice test items using the Maximum Likelihood Estimate of the confidence interval between Public and Private schools. From the findings it implies that students from both public and private schools are both intellectually included thereby making the difference in the reliability estimate between urban and rural schools non-significant. The result from this findings disagrees with Bibby and Peil (2004) who stated that students in private elementary schools outperformed those in public schools in terms of academic achievement, which implies that students from private schools have access to teaching and learning resources that will make them to be more intellectually inclined and subsequently have a higher reliability estimate than their counterparts in public schools who may likely not have access to those facilities. The study also disagrees with Adeyemi (2014) who observed that students at private schools did much better than their counterparts in public schools. This suggests that students from public schools where they have little or no access to teaching and learning resources that will make them to be less intellectually inclined and hence have a lesser reliability estimate of a test item than their counterparts in private schools who eventually have access to those facilities. Therefore, there is no significant difference in the reliability index of the Basic Education Certificate Examination (BECE) by National Examination Council (NECO 2022 Social Studies multiple choice test items using the Maximum Likelihood Estimate of the confidence interval between Public and Private schools in Benin Metropolis

Conclusion

Based on the findings from this study, it was concluded that the 2022 BECE Social Studies multiple choice test items conducted by National Examination Council (NECO) is reliable. Also, there was no significant difference in the reliability index based on school location, sex of students and school ownership using Maximum Likelihood Estimate Method of the confidence interval.

Recommendations

The following recommendations were made based on the findings from the study:

1. Examination bodies involved in BECE can use either of school location, sex of students, school ownership within the geographical population of the examination to determine the reliability index of their test items.
2. Based on the fact that the reliability of the test is very crucial to determining the true score of student in a given subject, students workshops, seminars and conferences should be organised for NECO BECE and other examination bodies, measurement experts, including researchers in educational testing field to equip themselves with objective measurement in terms of reliability index.
3. Experts in educational measurement in Africa should embrace the usefulness of MLE in obtaining the reliability index of items.



References

- Adeyemi, S. B. (2014). Comparative Study of Pupils Academic Performance between Private and Public Primary Schools. *World Journal of Education*, 4(4), 34-41.
- Agi, C. I. (2023). Issues in quality and confidence in assessment. In I. Oloyode; B. Nworgu & A. Ariyo (Eds.), *Manual of Critical Assessment Competencies for Tertiary Education Lecturers in Nigeria* 1st ed., JAMB Publishers. Pp. 105-124
- Alimi, O. S., Ehinola, G. B., & Alabi, F. O. (2012). School Types, Facilities and Academic Performance of Students in Senior Secondary Schools in Ondo State, Nigeria. *International Education Studies*, 5(3), 44-48
- Altman, D. G. (2005). Why we need confidence intervals? *World Journal of Surgery*, 29, 554-556.
- Asim, A. E. (2007). Examination Ethics and School Based Assessments in Sciences, Technology and Mathematics: A60 Proceedings oh Episteme 3 critical concerns for Universal Basic Education. *Proceedings of the 9th National Conference of National Association of Evaluators and Researchers*. Ago-Iwoye. Nigeria.
- Bibby, J., & Peil, M. (2004). *Secondary Education in Ghana Private Enterprise and Social Selection*. (2nd ed.) Longman.
- Daramola, C. O., & Olanireti A.M. (2019). Issues and Challenges Confronting Goals and Objectives of Social Studies in Nigeria. *Journal of Evaluation*, 4 (1), 42-53.
- Diogo, R. (2024). Maximum Likelihood Estimation (MLE). *Statistical Modelling in Data Science*. 3,15-23.
- Enu, O. V, & Okwilagwe E.A. (2015). Calibration of Mathematics and Geography Items for Joint Command Schools Promotion Examinations of Nigeria Army Education Corps in Nigeria. *African Journal of Theory and Practice of Educational Assessment*. 2, 40-60.
- Erford, B. T. (2013). *Assessment for Counsellors* (2nd ed.). Cengage Wadsworth.
- Eromosele, V. A., & Victory, O. (2014). *Influence of School Location on Senior Secondary School Students' Academic Performance in Mathematics in Edo State*. Mathematics Association of Nigeria 59th National Conference At: University of Benin, Edo State.
- Essien E. E., & Pauline C. N (2019). School Environment and Teachers' Job Performance in Social Studies. A publication of the Association for the Promotion of Innovation in Education (APIE). *Prestige Journal of Education*, 2(1), 48-56.
- Eyong, E. I. (2021). Estimating Reliability Index Using Practical Examples: Perspective from the Classroom Assessment and Evaluation Experience. *International Journal of Scientific Research and Engineering Development*. 4, 64-72
- Federal Republic of Nigeria (FRN, 2018). *National Policy on Education*. Lagos: Federal Ministry of Education.



- Flower C., & Melbery O. (2009). *School Facilities Management and Students' Academic Performance*. (1st ed.) Marylyn Computers Service.
- Imasuen, K., & Orheruata, M. U. (2022). Estimating the Reliability Index Using Confidence Interval: A Comparison of the Fisher Z and the Bootstrap Confidence Interval Method. *African Journal of Mathematics and Statistics Studies*, 5(1), 55-66.
- Kline, R. B. (2000). *Beyond Significance Testing: Reforming Data Analysis Methods in Behavioural Research*. (2nd ed.). Methune and Company.
- Livingstone, S. A. (2018). *Test Reliability-Basic Concepts* (Research Memorandum No. RM-18-01). Princeton, NJ: Educational Testing Service.
- National Council for Social Studies (NCSS) (2011). *Social Studies for Early Childhood and Elementary School Children: st preparing for the 21 Century*. Retrieved from <http://www.socialstudies.org/standards/execsummary>. Retrieved on 10/11/ 2011.k.
- Omorogiwa, O. K. (2010). *An Introduction to Educational Measurement and Evaluation*. (2nd ed.). Mace Perfect Publishers.
- Oribhabor, C. B., & Osaze D.E. (2016). Determining the Reliability and Content Validity of the Mathematics Tests Constructed by Senior Secondary *African Journal of Education, Science and Technology*, 3(2).
- Rossi & Richard, J. (2018). *Mathematical Statistics: An Introduction to Likelihood Based Inference*. (2nd ed.). John Wiley & Sons.
- Sidhu, K. S. (2012). *New Approach to Measurement and Evaluation*. (1st ed.). Sterling Publishers Private Limited.
- Uline, C., & Megan, T. (2008). The Walls Speak: the Interplay of Quality Facilities, School Climate, and Student Achievement. *Journal of Educational Administration*, 46(1), 55 - 73.
- Uwah, V. I., Magnus - Arewa, A. E., & Bokolo, F. (2020). Perceived Challenges of Educational Assessment and Evaluation by Stakeholders in Uyo Education Zone, Akwa Ibom State, Nigeria. *Journal of Innovations in Educational Assessment*, 2(2), 138 – 158.
- Xianghong, L. (2016), *A Comparison of Three Estimation Methods in Linear Regression*. Analysis 4th International Conference on Machinery, Materials and Information Technology Applications (ICMMITA) Advances in Computer Science Research, volume 71.
- Yekti. W., Hakiim, N. R., & Titin. S. (2024). *Performance Comparison between Maximum Likelihood Estimation and Variation Method for Estimating Simple Linear Regression Parameter*. ITM Web of Conference 61, <http://.org/10.1051/tmconf/20246101010>